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Cognitive ability, parental socioeconomic position and internalising and externalising problems in adolescence: Findings from two European cohort studies

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Abstract We investigated whether cognitive ability (CA) may be a moderator of the relationship of parental socioeconomic position (SEP) with internalising and externalising problems in adolescents. We used data from two longitudinal cohort studies; the Avon Longitudinal Study of Parents and Children (ALSPAC) and the Tracking Adolescents' Individual Lives Survey (TRAILS). Indicators of SEP were mother's education and household income. CA was estimated with IQ scores, derived from the Wechsler Intelligence Scale for Children. Internalising and externalising problems were measured with the Strengths and Difficulties Questionnaire in ALSPAC and with the Child Behavior Checklist in TRAILS. Logistic regression analyses were used to estimate the relative index of inequality (RII) for each outcome; the RII provides the odds ratio comparing the most to least deprived for each measure of SEP. In fully adjusted models an association of mother's education with externalising problems was

observed [ALSPAC RII 1.42 (95%CI: 1.01–1.99); TRAILS RII 2.21 (95%CI: 1.37–3.54)], and of household income with internalising and externalising problems [pooled ALSPAC & TRAILS internalising RII 1.30 (95%CI: 0.99–1.71); pooled ALSPAC & TRAILS externalising RII 1.38 (95%CI: 1.03–1.84)]. No consistent associations were observed between mother's education and internalising problems. Results of stratified analyses and interaction-terms showed no evidence that CA moderated the association of SEP with internalising or externalising problems.

Keywords Adolescence · Socioeconomic factors · Mental health · ALSPAC · TRAILS · Cognitive ability

Abbreviations

CA Cognitive ability
SEP Socioeconomic position

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Introduction

Two important predictors of internalising and externalising problems in adolescents are parental socioeconomic position (SEP) [1–7] and cognitive deficits [8–13] or abilities (CA) in the adolescent [14]. Previous studies provided substantial evidence that children and adolescents from lower socioeconomic groups more often manifest internalising and externalising problems, although the precise relation between SEP and specific types of problems remains unclear [15]. Among adolescents, lower parental SEP is related to most of the common mental health problems, including internalising problems [2], depression [3–5, 7] and delinquent and rule-breaking behaviour [1, 6, 7].

Low parental SEP is believed to be an important risk factor for offspring mental health problems because it reflects exposure to a disadvantageous social environment during important developmental phases early in the life course. Such disadvantaged environments may be characterised by economic hardship, heightened levels of stress, poor parenting, and child abuse within the family, or by neighbourhood factors such as poor housing, substance abuse and delinquency. Associations of these factors with internalising or externalising problems in children and adolescents have been demonstrated [6, 7, 15–21].

To improve our understanding of the aetiology of internalising and externalising problems it is necessary to understand better how the two predictors—SEP and CA—might work together. In the current study we investigated the possibility that CA is a moderator of the association between parental SEP and internalising and externalising problems in adolescents.

Our hypothesis that CA would modify the association of SEP with adolescent behaviour was based on the following reasoning. Higher CA has been shown to be associated with resilience to adverse circumstances in children and adolescents [22]. Children with a relatively higher CA appear to find it easier to regain functioning—to ‘rebound or recoil’—in the face of adversity than children with lower CA [23]. Given the definition of CA, or intelligence (“[...] a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience.” [24]), the greater resilience to adverse circumstances of children and adolescents with greater CA might be because these individuals are more successful in finding solutions for stressful situations or learn more quickly how to avoid them. If this is true, then it would be expected that, given similar circumstances of growing up in highly stressful environments (low SEP), adolescents with higher CA would have reduced odds of adverse outcomes compared to their lower CA peers. In other words, a high level of CA might buffer against the odds of internalising and externalising problems associated with growing up in a family with low SEP.

This hypothesis is in line with previous findings demonstrating that CA is associated with resilience and corresponds with stress-resilience models [22, 23, 25–27]. Resilience models in early life developmental research involve moderating relations with stress or specific stressors. Children who are faced with life stresses but develop into well functioning adolescents and adults regardless are labelled ‘resilient’ [25].

To our knowledge our specific hypothesis—that the increased odds of internalising and externalising behaviour in adolescents from families with lower SEP will be less apparent for adolescents with greater CA—has not been

previously tested. We therefore sought to examine this hypothesis using data from two longitudinal cohort studies; one from the UK—the Avon Longitudinal Study of Parents and Children (ALSPAC)—and one from the Netherlands—the TRacking Adolescents’ Individual Lives Survey (TRAILS). We chose to investigate the hypothesis in these two well-established cohort studies because evidence for or against the hypothesis would be strengthened if it were possible to replicate it in more than one relevant study. Consistency of findings between these cohorts will strengthen the basis for generalising them to adolescents in western societies in general.

Data and methods

Participants

Avon longitudinal study of parents and children

The target population consisted of pregnant women and their partners who were residing in Avon at the time of pregnancy, and who had an expected delivery date between 1st of April 1991 and 31st December 1992. The study started during the early phases of pregnancy of these women, and is ongoing. A total of 14,541 pregnant women were enrolled in the study and of these there were 13,971 live-born infants who survived to at least 1 year of age (48% female). A detailed description of the methodology of the study is provided elsewhere [28]. Ethical approval for the study was obtained from the Avon longitudinal study of parents and children (ALSPAC) Law and Ethics Committee and the Local Research Ethics Committees.

When the children were 8 years old they were invited to a clinic for psychometric and psychological testing. A total of 7,171 (~60% of those invited) attended the clinic. At age 13 the main caretaker of the child (in most cases the mother) was asked to fill out a questionnaire that included questions on behaviour. A total of 6,852 questionnaires were returned and 4,041 participants had complete data on all of the characteristics used in this study (50% female).

Tracking adolescent’s individual lives survey

The tracking adolescent’s individual lives survey (TRAILS) target population included all 10- to 11-year-old children living in three large cities and some rural areas in the North of the Netherlands. The present study involved data from baseline (T1; data collection March 2001–July 2002) and first follow-up (T2; September 2003–December 2004). At baseline, 76% of eligible households were enrolled in the study (N = 2,230). The mean age of the participants at baseline was 11.09 (SD = 0.56) years, and

50.8% of the participants were girls. Of the 2,230 baseline participants, 96.4% participated at T2 ($N = 2,149$). The mean age of participants at T2 was 13.55 ($SD = 0.53$), and at T2 51.2% of the participants were girls. Further information on the sampling procedure, methods and aims of the study is given elsewhere [29, 30].

The choice of dependent and independent variables and the timing of measurement were selected so that comparability between the studies was maximal.

Independent variables

Parental SEP was measured with mother's highest educational attainment and with household income. Other indicators of SEP were available in both studies, including occupational position of the mother and education and occupation of the father. However, we limited our analyses to mother's education and household income because these two indicators were the most comparable between the two studies and were considered to be important determinants of parent-child interaction within families.

Mother's educational attainment was obtained only at baseline in both studies (i.e. at 32 weeks gestation in ALSPAC and at age 10–11 years in TRAILS). This difference in timing of collecting data on maternal education is unlikely to compromise comparability between the two studies because education attainment changes little after early adulthood. The timing of measurement of household income used in our analyses also varied (age 4 years in ALSPAC and age 10–11 years in TRAILS). In absolute terms household income is likely to increase as children become older but over the 6 years difference in age we would anticipate that the relative positions of households would be similar.

Cognitive ability (CA) was measured with the Wechsler Intelligence Scale for Children (WISC-III) in ALSPAC [31], when the children were 8 years old. In TRAILS, two subtests (the vocabulary and block design subsets) of the revised Wechsler Intelligence Scale for Children (WISC-R) were administered at baseline when children were around 10–11 years old [32]. Total IQ scores derived from these tests were included in analyses as measures of CA. The total IQ in TRAILS was estimated from the two subtests with the method proposed by Sattler [33].

Mother's history of depression was measured with the Edinburgh Post-natal Depression Score [34] at two time points during pregnancy in ALSPAC. We used the mean of these two scores and divided this into tertiles to categorise the degree of mother's exposure to depressive problems. In TRAILS mother's history of depressive problems was assessed at baseline, during an interview. The interviewer presented the respondents with a description of the symptoms of depression and asked if the respondent had ever

suffered from these symptoms, and had received treatment or medication for these symptoms. Respondents were categorised into three mutually exclusive categories: (1) did not suffer from depressive problems; (2) ever suffered from depressive problems but never received treatment; and (3) ever suffered from depressive problems and had at least once received treatment.

Dependent variables

The term internalising disorders refers to the conditions whose central feature is disordered mood or emotion. Conditions designated as externalising disorders are ones whose central feature is deregulated behaviour [35]. Because the aetiology and development of internalising and externalising problems during adolescence differs we investigated relationships of parental SEP and CA with each separately. In ALSPAC, the main measure of internalising and externalising problems during adolescence was the parent-reported Strengths and Difficulties Questionnaire (SDQ) [36], which includes information on hyperactivity, conduct problems, emotional problems and peer problems. We selected the conduct problems scale and the emotional problems scale as measures of externalising and internalising problems respectively. Scale scores were derived by computing the mean score on the items of the scale (Appendix Table 1). The SDQ was administered when the children were aged 13 years.

In TRAILS information on internalising and externalising problems came from the Childhood Behavior Checklist (CBCL) [37]. We used the internalising and externalising problem scales as outcome. Scale scores were derived by computing the mean score on the items of the scale (Appendix Table 1). These outcomes in TRAILS were taken from the first follow-up (T2), which was administered when the mean age of children was 13.6 years. Although the number of items included in the SDQ and CBCL scales differs and CBCL can be considered to provide more detailed information, validation research has demonstrated that the SDQ conduct scale and emotional scale detect internalising and externalising problems, respectively, as well as the CBCL scales [38].

A chronology of the timing of measurements within ALSPAC and TRAILS is presented in Fig. 1.

Relative indices of inequality

We scaled all of the SEP measurements as relative indices of inequality (RII). RIIs enable direct comparison between cohorts of SEP variables as they take account of differences between cohorts in the proportions of the population in the different categories of a socioeconomic variable [39, 40]. For each indicator of SEP a score between 0 (highest

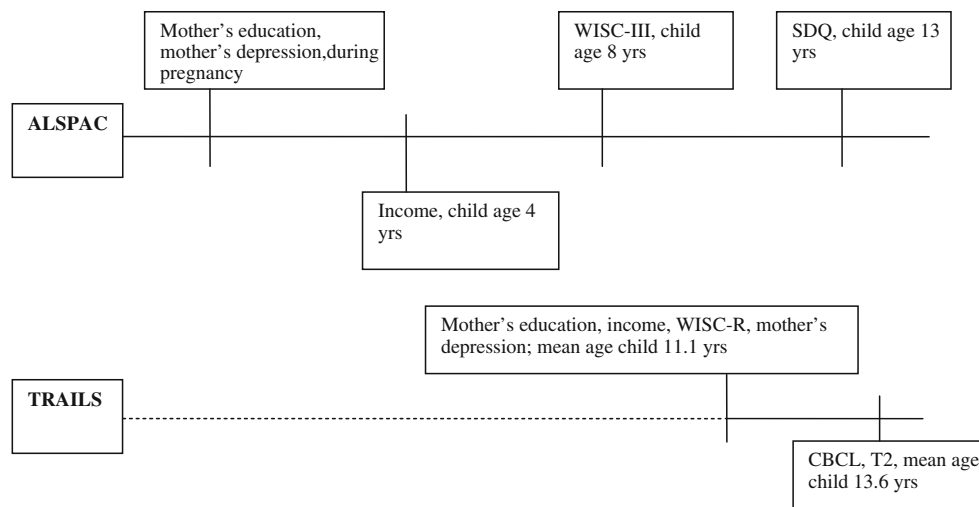


Fig. 1 Measurement time points within ALSPAC and TRAILS

SEP) and 1 (lowest SEP) was assigned to each category based on the proportion of the population above the mid-point in that category. For example, if 10% of the population are in the highest educational category participants in this group are represented by the range 0–0.1 and so are allocated the score 0.05 (0.1/2). If 20% of the population are in the next group, middle level education, then this education group is allocated a score 0.20 (0.1 + 0.2/2) and so on. The RII is then obtained by regressing the outcome on each of these SEP scores and is directly interpretable for each SEP indicator used as comparing participants of the lowest SEP (1) with the highest SEP (0).

Analyses

After performing basic descriptive analyses we performed logistic regression analyses separately on ALSPAC and on TRAILS data, with internalising and externalising problems (yes/no, with cut-off around the 85th percentile) as outcome measures. We chose this cut-off to identify a group with more severe problems, who would be more likely to be in need of or receive mental health care. Using a consistent cut-off in both studies also increased comparability between them as continuous distributions were likely to differ between the two cohorts. In a second step we examined the possibility of moderation by CA. We performed logistic regression analyses stratified by CA tertiles to examine differences in the magnitude of associations between SEP and internalising/externalising problems at different levels of CA. If our hypothesis were correct we would expect to see the weakest association in the group with highest CA and the strongest association in the group with lowest CA. We then performed logistic regression analyses on the complete samples, with an

interaction-term of SEP (as a continuous RII variable) with CA (in tertiles) included in the model, as well as the main effects of SEP and CA. We tested possible interactions with likelihood ratio tests between models with and without the interaction terms. These analyses were performed separately with internalising and externalising problems as outcome measures.

For both the main association and the association stratified by tertiles of CA and that including the interaction terms we progressively included additional covariables. In the basic model we adjusted for age and sex only; we then additionally adjusted for maternal depression (which might influence family SEP and be associated with offspring behaviours) and in the final model we mutually adjusted for each of the SEP measurements to examine whether they were independently associated with adolescent behaviours. Finally, analyses with internalising problems as outcome were adjusted for the presence of externalising problems and vice versa, because internalising and externalising problems are known to co-occur and associations of SEP with either one might be confounded by the other due to this.

All analyses were performed only on participants in each cohort who had complete data on all variables included in any analyses. After excluding participants with missing values on either one or more of the independent and dependent variables a total of 4,041 participants were included from ALSPAC, and a total of 1,703 cases from TRAILS.

Results

There were gradients in the amount of internalising and externalising problems between different education and

Table 1 Descriptive statistics and distribution of internalising (emotional) and externalising (behavioural) problems; ALSPAC

	N	Internalising		Externalising	
		Mean (SD)	Prevalence (%)	Mean (SD)	Prevalence (%)
Total (complete cases)	4,041	1.36 (1.66)	19.8	1.21 (1.40)	15.3
Mother's educational level					
Low (CSE or no education)	311	1.52 (1.92)	22.8	1.33 (1.50)	18.1
Middle (vocational or O level)	1,735	1.43 (1.69)	21.0	1.27 (1.45)	16.9
High (A level or degree)	1,995	1.27 (1.59)	18.3	1.13 (1.34)	13.4
Household income					
Lowest	1,528	1.48 (1.79)	21.4	1.35 (1.53)	17.9
Middle	1,342	1.32 (1.65)	19.7	1.12 (1.29)	14.4
Highest	1,171	1.25 (1.49)	17.8	1.11 (1.33)	13.0
Cognitive ability (IQ)					
Lowest tertile	1,338	1.56 (1.76)	23.2	1.40 (1.54)	19.3
Middle tertile	1,356	1.38 (1.68)	21.0	1.22 (1.40)	15.9
Highest tertile	1,347	1.14 (1.51)	15.2	1.00 (1.22)	10.7
Maternal depression (EPDS)					
Lowest tertile	1,468	1.09 (1.48)	14.9	0.98 (1.23)	10.8
Middle	1,256	1.29 (1.54)	18.1	1.14 (1.33)	13.9
Highest tertile	1,317	1.73 (1.89)	27.0	1.52 (1.59)	21.6

Table 2 Descriptive statistics and distribution of internalising (emotional) and externalising (behavioural) problems; TRAILS

	N	Internalising		Externalising	
		Mean (SD)	Prevalence (%)	Mean (SD)	Prevalence (%)
Total (complete cases)	1,703	.20 (.18)	15.1	.17 (.18)	18.0
Mother's educational level					
Low (\leq Lower secondary)	589	.21 (.19)	15.8	.20 (.20)	22.9
Middle (Higher secondary)	612	.21 (.19)	16.2	.17 (.18)	18.0
High (Higher vocational/university)	502	.19 (.18)	13.1	.13 (.15)	12.2
Household income					
Lowest	688	.22 (.19)	16.9	.19 (.19)	20.5
Middle	525	.21 (.18)	15.6	.17 (.18)	18.9
Highest	490	.17 (.17)	12.2	.13 (.16)	13.5
Cognitive ability (IQ)					
Lowest tertile	585	.21 (.20)	17.4	.21 (.22)	23.8
Middle tertile	657	.19 (.18)	12.0	.16 (.17)	15.7
Highest tertile	461	.20 (.18)	16.7	.14 (.14)	13.9
Maternal depression					
No	1,239	.18 (.17)	12.2	.15 (.17)	15.1
Yes	101	.25 (.19)	22.8	.20 (.21)	19.8
Yes + had treatment/medication	363	.27 (.21)	23.1	.23 (.21)	27.3

income groups in both studies (Tables 1, 2). The mean scores and the prevalence of those with internalising or externalising problems were higher with each lower level of mother's education or household income. The only exception was that mean scores and prevalence of internalising problems were not different between the group of

mothers with highest and middle levels of education. Internalising and externalising problems were also higher in each higher tertile of mothers with a history of depressive problems. In general, the crude data from both studies showed that all independent variables were associated with internalising and externalising problems.

Table 3 Associations of mother's educational level and household income with internalising and externalising problems; Relative index of inequalities (RII)

	Internalising			Externalising		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
ALSPAC						
Mother's educational level	1.30 (0.98–1.72)	1.18 (0.89–1.56)	1.10* (0.81–1.49)	1.79 (1.31–2.44)	1.58 (1.15–2.17)	1.42§ (1.01–1.99)
Household income	1.40 (1.05–1.86)	1.25 (0.94–1.67)	1.21‡ (0.88–1.65)	1.80 (1.31–2.47)	1.25 (0.94–1.67)	1.36† (0.96–1.92)
TRAILS						
Mother's educational level	1.24 (0.78–1.97)	1.15 (0.72–1.84)	0.97* (0.58–1.61)	2.65 (1.72–4.08)	2.49 (1.61–3.85)	2.21§ (1.37–3.54)
Household income	1.77 (1.06–2.94)	1.61 (0.96–2.69)	1.63‡ (0.93–2.84)	2.17 (1.34–3.52)	1.97 (1.21–3.21)	1.42† (0.84–2.40)

Note: Model 1 = bivariate; Model 2 = adjusted for maternal depression and sex; Model 3 = adjusted for maternal depression, sex and other socioeconomic indicator; * Pooled estimate: 1.06 (0.82–1.38), § Pooled estimate: 1.65 (1.25–2.17), † Pooled estimate: 1.38 (1.03–1.84), ‡ Pooled estimate: 1.30 (0.99–1.71)

The results of the logistic regression analyses in participants with no missing data were largely comparable between the two studies (Table 3). In both cohorts mothers with lower education had children who were more likely to have externalising problems than children of mothers with higher education and this association remained after adjustment for potential confounding factors. Maternal education showed no association with internalising problems. Household income was associated with both internalising and externalising problems. For each study the estimated association was imprecise (i.e. confidence intervals of these estimates were wide). Given that the point estimates were similar in each study we pooled the results from the two studies to improve precision. Meta-analysis was performed using a fixed effect model (since we had selected measurements from the cohorts that were similar and both cohorts are European populations, and because point estimates for each cohort were similar) using the 'meta' command in STATA 7.0 statistical package. The pooled estimates (combining both studies) of the association of maternal education were RII 1.06; CI 0.82–1.38 and RII 1.65; CI 1.25–2.17 for internalising and externalising behaviours, respectively. The equivalent associations for household income were RII 1.30; CI 0.99–1.71 RII 1.38; CI 1.03–1.84 for internalising and externalising problems, respectively. There was no strong statistical evidence of heterogeneity between the two studies in any of these associations (I^2 statistics 0–55% for the four pooled analyses and all P -values ≥ 0.14).

There was no strong statistical evidence that child's CA modified associations of parental SEP with childhood behaviour; all P -values for interaction were ≥ 0.36 (Table 4). Whilst some point estimates did look different across the thirds of CA for some associations, these were not consistent across the two cohorts or with each SEP measurement. They were also not consistent with our hypothesis that associations would be strongest in those in the lowest tertile of CA and weakest in those in the highest

tertile. The only exception to inconsistencies between cohorts was for household income which appeared positively associated with externalising behaviour in children in the lowest and highest thirds of CA in both cohorts, but inversely associated in those in the middle third of CA. This pattern was not in keeping with our hypothesis and not supported by statistical evidence ($P = 0.73$ and 0.92 , respectively in the two cohorts).

Discussion

Our results showed associations between 1) mother's education and externalising but not internalising problems and 2) household income and both internalising and externalising problems but no evidence that higher CA of children modified any of these associations.

Our main aim was to examine whether CA modified the association of parental SEP with childhood emotions and behaviours. Specifically, our hypothesis was that children with higher CA would be more resilient to the adverse effects of low SEP on emotional and behaviour problems. There were few consistent patterns between the two cohorts when we examined associations by thirds of CA but nothing in these results to support our hypothesis. The relatively small sample size of each cohort may have limited our ability to test this hypothesis, but if our hypothesis were true even with relatively small sample sizes we would have expected to see greater effects of lower SEP in those with worse CA than in those with better CA and we saw no such patterns at all. Furthermore, it seems likely that any modification will be modest indeed if it cannot be detected in a sample of about 4,000 (ALSPAC).

It is possible that CA does not noticeably protect adolescents from the negative effects of growing up in a low SEP environment on their internalising and externalising problems. The adverse environments associated with lower

Table 4 Associations of mother's educational level and household income with internalising and externalising problems, stratified by tertile of cognitive ability

	Internalising		Externalising	
	Mother's educational level	Household income	Mother's educational level	Household income
<i>ALSPAC</i>				
Cognitive ability				
Lowest tertile	1.22 (0.72–2.08)	1.18 (0.70–2.00)	1.43 (0.81–2.54)	1.52 (0.86–2.69)
Middle tertile	0.55 (0.32–0.93)	1.08 (0.64–1.81)	1.00 (0.56–1.79)	0.68 (0.38–1.21)
Highest tertile	1.20 (0.65–2.21)	1.14 (0.62–2.10)	0.91 (0.45–1.84)	2.36 (1.18–4.75)
<i>P</i> -value interaction	.42	.41	.88	.92
Likelihood ratio	–4.50		–0.11	
<i>TRAILS</i>				
Cognitive ability				
Lowest tertile	0.65 (0.28–1.51)	2.09 (0.77–5.62)	1.10 (0.51–2.36)	1.65 (0.69–3.97)
Middle tertile	2.65 (1.06–6.57)	1.50 (0.56–4.06)	2.89 (1.20–6.03)	0.81 (0.35–1.87)
Highest tertile	0.41 (0.13–1.27)	1.42 (0.55–3.64)	1.93 (0.64–5.82)	2.34 (0.78–7.01)
<i>P</i> -value interaction	.78	.36	.37	.73
Likelihood ratio	–2.56		–1.63	

SEP may be less amenable to modification by CA than other adverse factors that affect children's mental health problems. Since lower SEP is associated with a wide-range of adverse environmental exposures, including reduced material resources, reduced parenting ability, poorer diet, poor housing conditions, poor neighbourhood amenities and poor education provision, it still remains possible that greater CA may improve resilience to some (but not all) of these but be insufficient to modify their combined effect on internalising and externalising problems. Furthermore, CA might not provide much benefit in situations where adolescents themselves do not have control over the stressful situations such as with chronic family socioeconomic hardship. If this were true CA might become a modifier of the association of SEP with mental health problems in later life, without a notable effect in adolescence.

Other factors should be considered for understanding why some adolescents from low SEP families develop internalising or externalising problems whereas others do not. It might be that personality and temperamental factors are more salient interactive factors in relation to affective and behavioural outcomes than a general cognitive indicator such as IQ.

Consistent patterns were observed in data from both cohorts with regard to associations between maternal education and externalising problems, and with regard to household income and internalising and externalising problems. We believe that it is important to investigate associations separately for these two SEP indicators [41, 42]. SEP is a comprehensive multidimensional construct involving financial, social, material and cultural

circumstances [42, 43]. Household income and maternal education reflect different aspects of this construct, and they should therefore not be used interchangeably. Moreover they are likely to predict family processes and adolescent adjustment differently [44]. Lumping specific SEP indicators together into a scale would obscure diverging associations of these with internalising and externalising problems and ignore the fact that they occupy different positions in aetiological developmental pathways.

Associations between household income and adolescent mental health have been reported more often previously [7, 45, 46], than have associations between mother's education and these outcomes. Our finding that mother's education is associated with offspring externalising problems is in agreement with findings from previous studies [45, 47]. The lack of association with internalising problems was contrary to previous studies that had demonstrated associations of parental education (not necessarily the mother's) with internalizing problems in adolescents [45, 48, 49]. This discrepancy might be explained by our use of mother reports of internalising behaviour rather than self-reports by adolescents as in most previous studies, although most of the other associations reported here (including of maternal depression with outcomes) are consistent with existing literature.

There may be several reasons why adolescents from higher educated mothers have less externalising problems, including more favourable parenting styles (i.e. avoidance of harsh, humiliating and physical punishment), reduced exposure to stressful events within or in the surroundings of the family and less mental health problems in the parents.

Potential education-specific explanations that have been suggested for inequalities in mental health reflect human capital more than economic capital, and include fostering of academic achievements of children, and promotion of social competence [44].

Study strengths and limitations

The main strengths of this study are the use of two well characterised cohorts to examine our hypothesis. To our knowledge this hypothesis has not been tested in other cohorts. ALSPAC has a relatively large sample size and the TRIALS cohort provided a means of replicating any findings in order to provide more robust findings. We could only examine parent-reported measures of internalising and externalising problems. Problem scores based on parent- and child-reports in observational studies correlate only moderately [50] and it is commonly recognized that multiple informants contribute unique information that can improve the overall measure of behavioural problems [50, 51]. For this particular study it means that the lack of moderation by CA refers to that aspect of adolescent problems observed by the parents (mostly the mother). In other words; adolescents' CA does not seem to modify the association of SEP with behavioural problems of the child as reported by the mother. There is a possibility that results may have been different if the problems had been reported by the children themselves.

Associations presented in this study were adjusted for mother's history of depression. Our justification for this is that mother's depression could influence her educational attainment and household income as well as being associated with offspring behavioural or emotional problems, and could hence be a confounding factor. However, we acknowledge that mother's depression could also mediate the association of parental SEP with offspring behaviours or emotions (i.e. lower SEP might cause maternal depression which in turn affects childhood behaviours or mood). In both cohorts adjustment for maternal depression did result in attenuation of the associations but we cannot ascertain from our data whether this is due to confounding or mediation.

Missing data in both studies was associated with most of the independent and dependent variables in the study. In ALSPAC, mothers of children for whom data could not be included in this study because of drop-out during earlier phases of the study or (item) non-response on core variables were lower educated on average (Pearson chi-square value 512.8 [$df = 4$], P -value $< .001$), had higher depression scores (mean depression scores 14.6 and 12.6 respectively, P -value t -test $< .001$), and had a relatively

low family income (Pearson chi-square value 312.7 [$df = 4$], P -value $< .001$). Adolescents for whom information on IQ was available but who could not be included in the study because of missing data on covariates had lower IQs on average (mean IQs respectively 101.2 and 106.3, P -value t -test $< .001$). Adolescents for whom information on internalising and externalising problems at age 13 were available, but who could not be included because of missing data on covariates had higher scores on internalising and externalising problems (mean internalising problems 1.53 and 1.36, respectively, P -value t -test $< .001$; mean externalising problems 1.30 and 1.21, respectively, P -value t -test $< .001$). In TRIALS, non-participants at baseline were more likely to be from lower SEP families. Based on teacher ratings, there were no indications that non-participants at baseline had higher internalising or externalising scores [29]. Adolescents who could not be included in this analysis because of missing data on covariates had on average lower IQ scores (mean IQs respectively 92.5 and 98.6, P -value t -test $< .001$), and had higher externalising problems scores at baseline but not higher internalising problem scores (mean externalising problems 0.26 and 0.24 respectively, P -value t -test $< .001$), had lower educated mothers (Pearson chi-square value 64.5 [$df = 4$], P -value $< .001$) and were from lower income families (Pearson chi-square value 127.4 [$df = 8$], P -value $< .001$).

Whilst we cannot test this possibility, missing data would importantly bias our results only if the associations that we have found were in the opposite direction in those excluded because of missing data. Likewise, the failure to prove our hypothesis regarding the moderation of familial SEP associations with adolescent behaviours would be incorrect if in those with missing data there was a marked moderating effect of CA on SEP. Nonetheless we can think of no reasons why this would be the case.

Conclusion

It is important to theorise and test mechanisms through which multiple risk factors work together in the emergence of internalising and externalising problems in the early life course [52]. We tested whether CA moderated the association of parental SEP with adolescent problem behaviours, because this hypothesis relates closely to stress-resilience models of early life development. We did not find support for our hypothesis in this study. Future studies should examine whether findings differ if child, rather than parental, reports of behaviours or emotions are used. Finally, it is also worth mentioning that CA might become a more important factor in relation to resilience against

environmental stress in later life and this should be examined in cohorts that have relevant data at older ages.

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Appendix

See Table 5.

Table 5 SDQ and CBCL items included in the study

ALSPAC—SDQ†		TRAILS—CBCL‡	
Internalising problems	1. Has often complained about headaches, stomach aches or sickness	Internalising problems	1. There is little that he/she likes
	2. Has many worries, often seems worried		2. Cries a lot
	3. Is often unhappy, down-hearted, tearful		3. Is afraid of animals, situations, places
	4. Is nervous/clingy in new situations, easily loses confidence		4. Is afraid to go to school
	5. Has many fears, is easily scared		5. Fears he/she might think or do something bad
			6. Feels he/she needs to be perfect
			7. Feels or complains that no one loves him/her
			8. Feels worthless or inferior
			9. Rather is alone than with others
			10. Is nervous, high-strung or tense
			11. Has nightmares
			12. Has constipations, holds faeces
			13. Feels dizzy
			14. Is overtired
			15.–21. Has physical problems without a known medical cause: aches or pains, headaches, nausea, problems with eyes, rashes or other skin problems, stomach aches or cramps, vomiting
			22. Feels too guilty
			23. Too fearful or anxious
			24. Refuses to talk
			25. Is taciturn
			26. Is self-conscious or easily embarrassed
			27. Is shy or timid
			28. Talks about wanting to kill him/herself

Table 5 continued

ALSPAC—SDQ†		TRAILS—CBCL‡	
Externalising problems	1. Has often had temper tantrums or hot tempers	Externalising problems	29. Is underactive, slow moving or lacks energy
	2. Is generally obedient, usually does what adults request (recoded)		30. Is unhappy, sad or depressed
	3. Often fights or bullies other children/teenagers		31. Withdrawn, does not get into contact with others
	4. Often lies or cheats		32. Worries
	5. Steals from home, school, or elsewhere		1. Drinks alcohol without permission of an adult
			2. Argues a lot
			3. Cruelty, bullying or meanness to others
			4. Demands a lot of attention
			5. Destroys his/her own things
			6. Destroys things of others
			7. Is disobedient at home
			8. Is disobedient at school
			9. Does not seem to feel guilty after misbehaving
			10. Does not obey rules at home, in school, or elsewhere
			11. Gets into many fights
			12. Hangs around with others who get into trouble
			13. Lies or cheats
			14. Physically attacks others
			15. Prefers being with older kids
			16. Runs away from home
			17. Screams a lot
			18. Sets fires
			19. Has sexual problems
			20. Steals from home
			21. Steals from other places
			22. Is stubborn, sullen or irritable
			23. Sudden changes in moods or feelings
			24. Sulks a lot
			25. Is suspicious
			26. Swears or uses obscene language
			27. Teases others a lot
			28. Thinks about sex too much
			29. Has temper tantrums or a hot temper
			30. Threatens people
			31. Smokes, chews, or sniffs tobacco
			32. Truant, skips school
			33. Is very noisy
			34. Uses drugs
			35. Destroys things, commits vandalism

Note: † Response options on the SDQ are: (1) Not true, (2) Somewhat true, (3) Certainly true, and (4) Don't know; ‡ Response options on the CBCL are: (1) Not at all true, (2) A little or sometimes true, (3) Certainly or often true

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